

2.13 1100-EM-1 Groundwater Interest Area

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This section describes groundwater flow and chemistry in the 1100-EM-1 groundwater interest area, which includes the former 1100-EM-1 Operable Unit and an area south of the Hanford Site (including the areas formerly designated as the 1100 and 3000 Areas) (Figure 1.0-1). Figure 2.13-1 shows facilities and monitoring wells in this region.

Groundwater flows primarily west to east from the Yakima River and discharges to the Columbia River (Figure 2.13-2). In the northeast part of the 1100-EM-1 groundwater interest area, groundwater flows northeast and converges with groundwater beneath the 300 Area before discharging to the Columbia River. In the east-central part of the 1100-EM-1 groundwater interest area, groundwater flow from the west is diverted to the northeast and southeast around a recharge mound created by the city of Richland's recharge ponds (near the North Richland Well Field) before discharging to the Columbia River. Recharge to the unconfined aquifer in the 1100-EM-1 groundwater interest area is primarily from agricultural irrigation between the Yakima and Columbia Rivers, as well as precipitation. Irrigation water is mainly extracted from the Columbia River.

Some of the main concepts associated with the 1100-EM-1 groundwater interest area include the following.

- Contaminants of concern are nitrate and trichloroethene.
- Concentrations of trichloroethene continued to decline, indicating the continued effectiveness of the selected remedy of monitored natural attenuation.
- Nitrate concentrations remained above the drinking water standard. The highest levels are associated with sources off the Hanford Site.
- Tritium remains detectable in groundwater, but far below the drinking water standard.
- Reduced monitoring requirements were put in place beginning in June 2007 in accordance with the recommendation from the second *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) five-year review.

The following sections provide details about the operable unit activities. Sections 2.13.1 and 2.13.2 describe contaminant plumes and concentration trends for the contaminants of concern and interest area activities, respectively. Trichloroethene and nitrate remain the contaminants of greatest concern in groundwater. Groundwater is monitored for the 1100-EM-1 groundwater interest area to assess the performance of natural attenuation of volatile organic compounds. Groundwater also is evaluated for trichloroethene breakdown products (e.g., vinyl chloride and 1,1-dichloroethene) and nitrate. Groundwater monitoring for the *Atomic Energy Act of 1954* (AEA) is integrated fully with CERCLA monitoring. There are no active waste disposal facilities or *Resource Conservation and Recovery Act of 1976* (RCRA) sites in this area.

*Nitrate and
trichloroethene are
the contaminants
of greatest
significance in
groundwater at the
1100-EM-1 Operable
Unit.*

2.13.1 Groundwater Contaminants

Plume areas (square kilometers) above the drinking water standard at the 1100-EM-1 Operable Unit:

Nitrate, 45 mg/L — 4.62

Primarily from offsite sources.

Trichloroethene concentrations continue to decrease in all plume areas near DOE's Horn Rapids Landfill.

Wells in the 1100-EM-1 groundwater interest area are sampled for chlorinated hydrocarbons (primarily trichloroethene) and co-contaminants identified under CERCLA and AEA: nitrate, tritium, gross alpha, uranium, ammonia, and gross beta.

2.13.1.1 Trichloroethene

Trichloroethene contamination occurs at levels below the 5 µg/L drinking water standard in the 1100-EM-1 groundwater interest area beneath the U.S. Department of Energy's (DOE) inactive Horn Rapids Landfill and offsite in wells monitored by AREVA NC Inc.¹ The distribution of trichloroethene in the upper part of the unconfined aquifer follows the northeast flow direction toward the 300 Area. The thickness of the unconfined aquifer in this area is ~5.6 to 9 m. Most of the wells used to monitor trichloroethene have screen intervals that penetrate the upper ~4.5 to 7.5 m of the unconfined aquifer.

Trichloroethene sample concentrations continued to be less than 5 µg/L in all AREVA wells during the first quarter of FY 2008 (E06-01-20074Q, *2007 4Q Groundwater Report*). The maximum trichloroethene concentration during the quarter was 1.1 µg/L immediately downgradient of the process lagoons. The past use of solvent to install and maintain process lagoon liners at AREVA is the only potential source of trichloroethene identified in the eastern portion of the 1100-EM-1 groundwater interest area (DOE/RL-92-67, *Draft Limited Field Investigation/Focused Feasibility Study for the 1100-EM-2, 1100-EM-3, and 1100-IU-1 Operable Units, Hanford*). With the completion of the fourth quarter 2007 report, AREVA is no longer required to publish quarterly RCRA groundwater monitoring data. They will continue to produce an annual report on results of the Groundwater Monitoring Program for their facility; however, a 2007 annual summary report was not produced. AREVA will published a calendar year 2008 annual report in calendar year 2009 and pertinent information from that report will be reported in the FY 2009 Hanford Site annual groundwater report.

Trichloroethene concentrations have decreased in all the areas near the DOE's Horn Rapids Landfill. Trichloroethene concentrations decreased by an order of magnitude in this area since monitoring began in 1990. In FY 2008, trichloroethene concentrations downgradient of the landfill were all less than the 5 µg/L regulatory limit, as well as being less than the detection limit of 1.0 µg/L. The decreased concentrations in the majority of wells downgradient of the DOE's Horn Rapids Landfill suggest that natural attenuation (e.g., biodegradation, passive pumping) continues to reduce the plume mass. Section 2.12.1.2 discusses trichloroethene in the 300 Area.

Potential breakdown products of trichloroethene, including vinyl chloride and 1,1-dichloroethene, remained undetected at the minimum detection limit of 1.0 µg/L during FY 2008.

The city of Richland monitors groundwater in the upper part of the unconfined aquifer quarterly for chemical constituents at their Horn Rapids Sanitary Landfill (formerly Richland Landfill), located ~1 km south of the Hanford Site boundary. Various chlorinated hydrocarbons (e.g., tetrachloroethene, trichloroethene, and

¹ AREVA NC Inc., Richland, Washington (formerly Exxon, Siemens; is part of Framatome).

vinyl chloride) continue to exceed drinking water standards in several monitoring wells. During FY 2008, chlorinated hydrocarbons were below their respective minimum detection limits at onsite well 699-S31-1, just northeast of the city's sanitary landfill.

A confined aquifer found near the base of the Ringold Formation also is monitored for trichloroethene downgradient of the DOE's inactive Horn Rapids Landfill. Two wells, one upgradient and one downgradient of the landfill, monitor this confined aquifer. This confined aquifer lies between a clay-silt aquitard and the basalt surface, at a depth of ~18 to 21 m below the water table. Trichloroethene has not been detected in this confined aquifer since monitoring began in 1991, suggesting the trichloroethene plume in the unconfined aquifer did not migrate downward into the underlying confined aquifer.

2.13.1.2 Nitrate

Nitrate concentrations above the drinking water standard (45 mg/L) are found over much of the 1100-EM-1 groundwater interest area (Figure 2.13-3) and continued to increase in a number of wells in FY 2008. Some of the highest nitrate levels occur near an offsite facility (AREVA) and DOE's inactive Horn Rapids Landfill. The highest nitrate concentration in this area was 370 mg/L immediately downgradient of the AREVA facility. Nitrate data for the AREVA wells are reported in E06-01-20074Q. Nitrate contamination in this area is likely the result of industrial and agricultural uses off the Hanford Site. Agricultural uses include application of fertilizers onto irrigation circles to the west of the 1100-EM-1 groundwater interest area (Figure 2.13-3).

Nitrate concentrations continued to be elevated in wells downgradient of the DOE's inactive Horn Rapids Landfill in FY 2008. The highest nitrate concentration was 310 mg/L. The distribution of nitrate and shape of the nitrate plume near the AREVA facility and the Horn Rapids Landfill indicates that nitrate in these areas continues to migrate in a northeast direction toward the 300 Area (Figure 2.13-3). Groundwater and aquifer tube sample data indicates that groundwater with nitrate levels above the drinking water standard has reached the Columbia River immediately south of the 300 Area. Aquifer tube AT-3-8-M, immediately south of the 300 Area, had a maximum nitrate concentration of 52.2 mg/L. A water sample collected from spring DR42-2 at the 300 Area had a nitrate concentration of 15.5 mg/L, while the river had nitrate concentrations of ~4 mg/L (PNNL-17603).

2.13.1.3 Tritium

The 200 Area tritium plume extends south into the 300 Area, but concentrations of less than the drinking water standard (20,000 pCi/L) continue to be reported in the 1100-EM-1 groundwater interest area (Figure 2.13-4). Tritium continues to be closely monitored because of its proximity to the city of Richland's North Well Field. The background geometric mean tritium concentration in the upper part of the unconfined aquifer was 63.9 pCi/L (DOE/RL-96-61). Although tritium levels were above this background in several wells near the city of Richland's North Well Field during FY 2008, these levels are far below the drinking water standard (20,000 pCi/L). Trends in tritium concentrations in wells west and north of the city of Richland's North Well Field have fluctuated in the last few years.

Tritium is not migrating in groundwater from the Hanford Site 200 Area tritium plume to the city of Richland North Well Field. The following factors limit the

Nitrate contamination in groundwater is the result of industrial and agricultural uses off the Hanford Site.

Monitoring data show that the Richland North Well Field is not contaminated by the Hanford Site tritium plume through the groundwater flow system.

migration of the tritium plume into the east portion of the 1100-EM-1 groundwater interest area.

- Groundwater generally flows from west to east between the Yakima River, a recharge source, and the Columbia River.
- Artificial recharge from agricultural irrigation in the west and central portions of the 1100-EM-1 groundwater interest area south of the Hanford Site contribute to the eastward and northeastward flow.
- Groundwater flow is directed radially outward from the elevated groundwater levels at the city of Richland's North Well Field because of ponds used to recharge the well field.

These factors produce converging groundwater flow lines in the 300 Area where groundwater discharges to the Columbia River (Figure 2.13-2). Figure 2.13-4 shows a region of low tritium concentrations between the 200 Area tritium plume and the elevated tritium concentrations near the North Richland Well Field and recharge ponds. Current information does not indicate that the tritium plume is migrating southward to or affecting the city of Richland's North Well Field. Section 2.12.1.3 discusses tritium in groundwater in the 300 Area.

2.13.1.4 Gross Alpha and Uranium

Elevated levels of gross alpha and uranium occur downgradient of an offsite industrial facility (AREVA) near DOE's inactive Horn Rapids Landfill. Gross alpha data for the AREVA wells are reported in E06-01-20074Q. During FY 2008, several wells downgradient of the AREVA facility showed elevated gross alpha levels, with highest maximum concentration of 135 pCi/L, immediately downgradient of the AREVA facility near Horn Rapids Road. Gross alpha is largely attributed to uranium from industrial use at the facility. If gross alpha is attributed to only uranium, then 121 pCi/L of gross alpha is equivalent to 201 µg/L of uranium, which is above uranium's drinking water standard (30 µg/L).

The FY 2006 annual groundwater report (PNNL-16346) discussed distribution of uranium near the DOE's inactive Horn Rapids Landfill. FY 2008 uranium concentrations in wells downgradient of the Horn Rapids Landfill increased slightly (maximum of 23.8 µg/L) from FY 2007 (maximum of 20.4 µg/L). The presence of uranium at these locations likely is associated with the plume moving northeast from the AREVA facility.

2.13.1.5 Ammonia

During FY 2008, ammonia continued to be detected in several wells downgradient of the AREVA facility. Concentrations of ammonia in AREVA wells generally remained steady in FY 2008 (E06-01-20074Q). The highest concentration detected was 10.1 mg/L (as NH₃). Ammonia is typically converted to nitrate by the nitrification processes.

2.13.1.6 Gross Beta

Gross beta continued to be detected in wells (E06-01-20074Q) downgradient of AREVA during FY 2008. The highest average gross beta measurement in FY 2008 was 69.6 pCi/L. The elevated gross beta is likely related to uranium and its daughter products in the groundwater.

*Uranium
contamination is
present near DOE's
inactive Horn Rapids
Landfill, but the
source is located
offsite.*

2.13.2 Groundwater Interest Area Activities

The 1100-EM-1 groundwater interest area, including DOE's inactive Horn Rapids Landfill, was placed on the National Priorities List in 1989 and de-listed from the National Priorities List in 1996. Results of the CERCLA investigation for the 1100-EM-1 groundwater interest area are presented in the final remedial investigation study (DOE/RL-92-67) and the record of decision (EPA/ROD/R10-93/063, *Declaration of the Record of Decision for the 1100 Area*). The selected remedy for groundwater is monitored natural attenuation of volatile organic compounds, with institutional controls on drilling of new water supply wells. Monitoring includes analysis of trichloroethene, its breakdown products (e.g., vinyl chloride and 1,1-dichloroethene), and nitrate in wells downgradient of the Horn Rapids Landfill, as recommended in the sampling plan (PNNL-12220, *Sampling and Analysis Plan Update for Groundwater Monitoring – 1100-EM-1 Operable Unit*).

The second CERCLA five-year review, published in November 2006 (DOE/RL-2006-20), stated the following, "The plume mass and concentration have been adequately reduced to be protective of human health and the environment. Groundwater monitoring for the 1100-EM-1 Operable Unit is no longer necessary but continues following an extended period of monitoring that shows contaminant levels are below the maximum contaminant level and continue to show a downward trend." Figure 2.13-5 provides the trend for trichloroethene in the compliance wells.

The review identified the following action: "Submit a change request to modify groundwater monitoring for the 1100-EM-1 Operable Unit." This action was completed with Tri-Party Agreement Change Notice 163, approved in June 2007. Through this approval, groundwater monitoring has been reduced to annual monitoring of three of the original network wells. All three wells were sampled for volatile organic compounds in FY 2008 (Appendix A).

The remedial action objectives for the 1100-EM-1 Operable Unit (EPA/ROD/R10-93/063) are as follows.

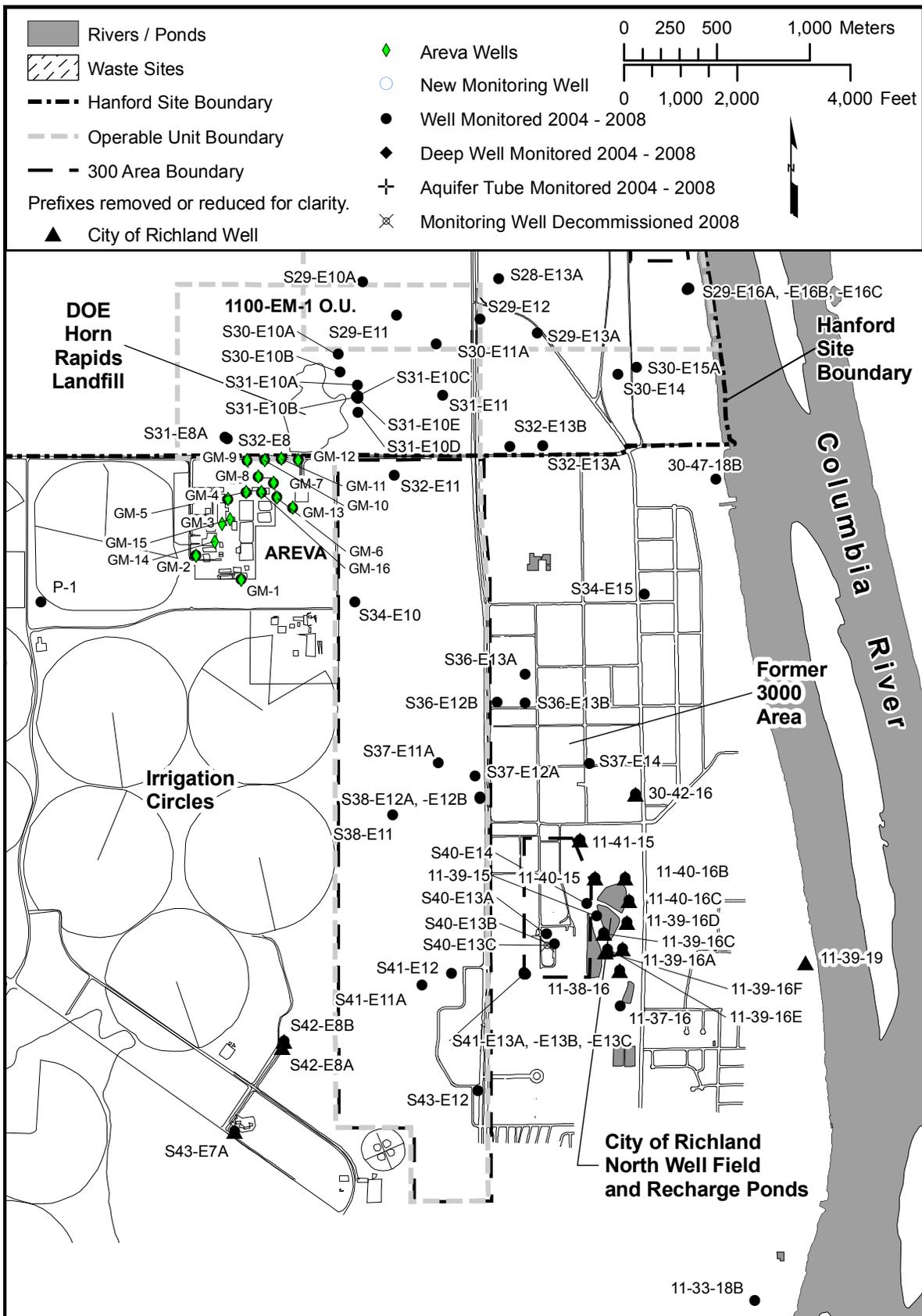
- ***Attain concentration of less than 5 µg/L trichloroethene at designated point of compliance.***
- ***Protect environmental receptors in surface waters by reducing groundwater contaminant concentrations in the plume.***

The CERCLA five-year review action to reduce monitoring requirements was completed and documented in a Tri-Party Agreement change notice.

Groundwater monitoring in the 1100-EM-1 groundwater interest area includes the following monitoring activities.

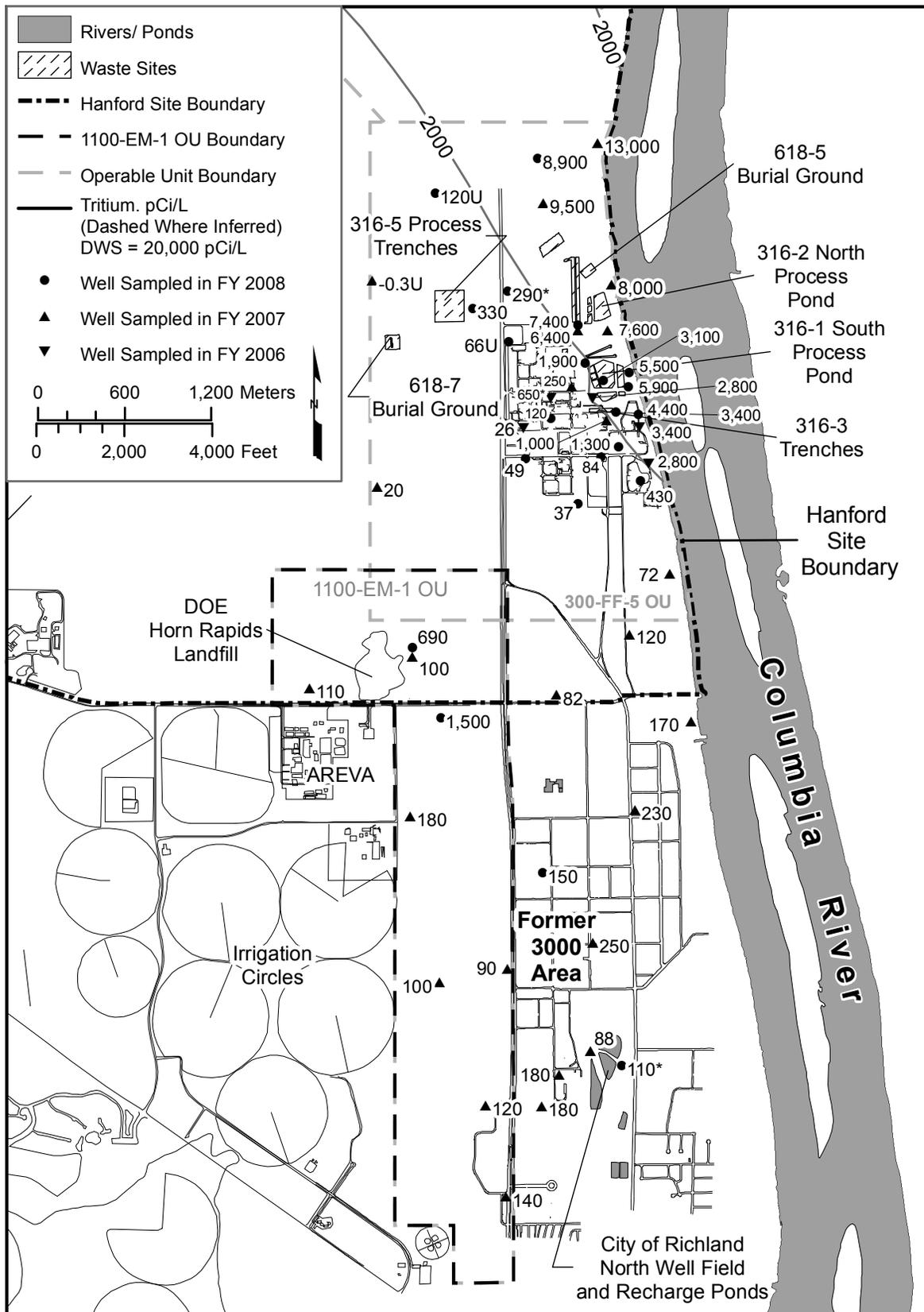
- ***Three wells are scheduled for annual sampling for CERCLA (Appendix A). All were sampled as planned.***
- ***Additional wells are scheduled for annual to semiannual sampling for AEA.***

Figure 2.13-1. Facilities and Groundwater Monitoring Wells in the 1100-EM-1 Groundwater Interest Area.



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Figure 2.13-4. Average Tritium Concentrations in the 1100-EM-1 Groundwater Interest Area and Adjacent 300 Area, Upper Part of Unconfined Aquifer.



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Figure 2.13-5. Trichloroethene Concentrations in 1100-EM-1 Operable Unit Compliance Wells.

